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ATTENTION TO THE UNITED KINGDOM AND ISRAEL(U) OFFICE OF  
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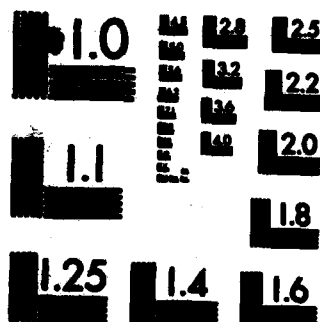
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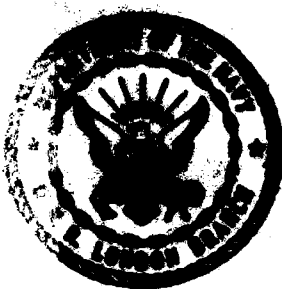
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## CNR LONDON REPORT

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MARINE AND COASTAL GEOLOGY IN EUROPE, WITH SPECIAL  
ATTENTION TO THE UNITED KINGDOM AND ISRAEL

ROBERT DOLAN

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## MARINE AND COASTAL GEOLOGY IN EUROPE, WITH SPECIAL ATTENTION TO THE UNITED KINGDOM AND ISRAEL

These are not good times in Europe for research in general, and for marine and coastal geology in particular. Although the economy in the US shows evidence of an upturn, the worldwide recession is still being felt throughout Europe and the Middle East. Support for basic and applied research has been reduced in recent years in every European and Middle Eastern nation I've visited. In some countries, such as the UK and Israel, cuts in research support have been severe, ranging up to 25 percent over inflation. Anyone interested in what's happening in UK science in general should, for certain, read "Dead-end for British Research" in the 26 July 1984 issue of *Nature*. The implications have been profound across the board, and the troubles are far from over. Outstanding marine scientists still command support, although at greatly reduced levels. The scientists that are suffering most are those just below "outstanding"; that is, the very good ones, and of course the graduate students. Students are also having trouble finding jobs.

This report is a summary of my observations and impressions of the state of the art of research in marine and coastal geology under way in the UK and Israel. While at ONRL I covered a much wider range of subjects from climatology to geophysics, so this report is based on only a part of my European environmental information base. Regardless, I think it's an accurate overall assessment.

Marine geology, as I treated it while with ONRL, was separated into deep-sea geology and coastal or shallow-water geology (continental shelves).

### UK Coastal Geology

Coastal geology in Europe today is in the doldrums. Budget cuts and administrative decisions to consolidate research facilities have resulted in a significant decrease in research activities. Much of the research being supported can be classed as applied science and engineering. Fundamental questions are not being pursued as rigorously in many fields.

In the UK about 20 universities and several government laboratories carry out research in some aspect of coastal geology. Over the past decade the UK universities have produced more than 2500 PhDs in marine science and in coastal geology and geomorphology. However, the number of students has decreased sharply in recent years as Natural Environment Research Council (NERC) assistantships have been cut back and the market for PhDs in the marine sciences has diminished.

The University of Bristol has an interdisciplinary program under way to study the Severn Estuary and the Bristol Channel. They're concerned with every aspect of the evolution of the estuary from the hydrology of the rivers entering it to the marine life. The University College of Swansea on the Welsh side of the Bristol Channel collaborates in the Severn Estuary project. In addition, many departments there have researchers interested in marine and coastal problems; however, marine science at Swansea has recently suffered a major setback, which I'll discuss shortly.

In London, the Departments of Geology and Zoology of Kings College have programs in sedimentary processes and environments in the Thames Estuary. The Geology and Oceanography departments of the University College of Wales, Bangor, have worked on sedimentation in the Irish Sea for many years. The physical oceanographers at Bangor are also working on internal waves and sediment transport in the Irish Sea. The School of Environmental Sciences at the University of East Anglia, Norwich, has a number of programs concerned

with movements of sediment in estuaries and along shore and on the shelf-bed, and with interchanges between nearshore and offshore zones. The University of Aberdeen has several people doing research on the geomorphology of coastal areas, including investigations of sand dunes.

Much marine and coastal work in the UK is carried out in research laboratories operated by the NERC. (NERC is one of five of the UK's research councils set up by the central government and responsible to the Secretary of State for Education and Science.) Among the more important of these is the Institute of Oceanographic Sciences (IOS), with laboratories at Wormley, Birkenhead near Liverpool, and Taunton. IOS is undergoing significant change, which I will discuss later in this report. The Institute of Geological Sciences (NERC-supported) has a major concern with research into coastal and continental-shelf problems; The Nature Conservancy, while primarily concerned with biological research, maintains a coastal ecology research station at Norwich.

In addition to the activities of the central government, a number of local authorities and private associations maintain coastal study and research centers. Among the best known of these are the Field Studies Council stations at Slapton in Devon, and Dale and Orierton in Pembrokeshire.

In a recent review of government-sponsored research, NERC summarized its support for marine science programs under these headings:

1. The structure and composition of the UK continental shelf.
2. Currents and circulation of UK coastal seas and estuaries.
3. Tides and oscillations of sea level.
4. Physical and chemical properties of seawater.
5. Properties and movements of the seabed surface.
6. Biological processes in the marine environment.
7. Pollutants in the marine environment.

Support for basic research in coastal geology has been cut back so severely over the past 5 years that proposals that grade "excellent" on NERC's scale are not now being funded. In fact, I was told at Cambridge that there hasn't been a single new NERC-supported research project started in a UK university in over a year! NERC student research assistantships in coastal geology have been reduced to only a few for the entire UK. Finally, NERC has just announced (August 1984) that IOS Taunton, the branch of IOS that specialized in coastal geology—especially sediment transport—will be closed down over the next year.

IOS Taunton has employed or supported most of the UK's best coastal investigators, so closing the unit will have significant impact on this field. The staff of 35 or so will be transferred to IOS Bidston or IOS Wormley; however, I've learned that perhaps fewer than 10 of the Taunton group will actually move. The majority are retiring or simply quitting and finding jobs in industry. NERC headquarters people view this with mixed feelings. On the one hand they don't like seeing the unit disrupted with 75 percent attrition, but it is an opportunity to bring in new people with new ideas and specialties.

The two institutions in the UK that will expand their coastal research programs in the near future are the University of Southampton and the University of Wales at Bangor. Both are scheduled for increased NERC support as the oceanography programs at the University of Liverpool and the University of Swansea are discontinued. This is an effort to consolidate the staffs and resources in UK oceanography at two rather than four universities.

The coastal program at Southampton is focused on land-use and coastal engineering, not basic research. The coastal program at Bangor is called The Unit for Coastal Studies, which specializes in the physical oceanography of coastal and shelf-sea areas, with particular emphasis on modeling circulation and mixing processes. In recent months the new Deputy Director, Dr. Alan Elliott, has taken steps to broaden the Unit's field of interest. The goal is to make the Unit a leading center for applied oceanographic research. But by US standards this is a very modest activity.

In summary, I don't look for any major new thrusts in coastal science in the UK over the next several years. This is not to suggest that the British won't continue to make important contributions. UK coastal scientists are good, without question. But it's unlikely that we'll see activity similar to their glory years of 1969-79. The support just isn't here, and what there is is being reduced. Young people are avoiding the field, or turning to industry rather than research, and older people are retiring.

#### Marine Geology in the UK

In UK marine geology the situation is, with one or two exceptions, essentially the same as for coastal geology. IOS Wormley has lost staff and financial support in recent years due to NERC cutbacks. There are some very good investigators working at IOS; geology and geophysics are no exception. The people working on the side-scan sonar GLORIA data are an exceptionally able group; however, I was told that the rental of GLORIA to the US to map the US western continental shelf was a "godsend" because IOS really needed the money. Budget cuts and the weakness of the pound versus US dollars have really dampened the IOS program.

The one bright spot in UK marine geology in my opinion is the research team at the Bullard Laboratories, Department of Earth Science, University of Cambridge. The staff at the Bullard Lab has made major contributions over the past two decades to the understanding of the ocean basins and plate tectonics. Names such as Vine, Matthews, and McKenzie are like the honor roll in international marine geology. In 1983, at the biennial meeting of the European Union of Geosciences, McKenzie was awarded the Wegener Medal, and 2 months later the Geological Society honored him with the award of the Wollaston Medal in particular recognition of his work on mantle convection.

In 1983-84 there were 18 geologists and geophysicists at the Bullard Lab working in marine geophysics, deep seismic reflections profiling, crust and mantle structure, continental deformation, geomagnetism, mantle connection, and the origin of sedimentary basins. NERC support for the Bullard group is consistent, but even they are now having funding problems. But they do attract the very best earth science students in the UK.

The director of the marine geophysics group at the Bullard Lab is Robert White, a young man (in his early thirties) who's already well known in geophysical circles. I talked with him at length several times during my tour with ONRL. White says of the future that the Bullard people will do less work in the deep ocean basins and more research on the continental margins because "we really know a lot about ocean basins, far more than we know about the continents." By that he means that the evolution of the ocean crust can be and has been observed at the mid-ocean ridges and is now fairly well understood, whereas the origin of the continental crust is more obscure and not as well known. This suggests that the Bullard Lab activity over the next 5 years will definitely include focus on the continental margins and sedimentary basins, such as the North Sea.

Another program under way in the UK that I believe is state of the art and certainly worth following is the Royal Aircraft Establishment's (RAE) remote sensing program as applied to shallow water oceanography. RAE staff, in collaboration with IOS and university investigators, are conducting an experiment with the synthetic aperture radar (SAR) that will be flown on the SIR-B Space Shuttle mission whenever it flies. The British research team consists of two groups, one working with shallow-water bathymetry and seabed morphology, and the other with deep-water oceanography (mostly waves).

The shallow-water team will focus on the shelf area of the Bristol Channel on the Norfolk coast. This is the same area that was widely publicized with the excellent Seasat SAR image of large-scale sand waves, internal waves, and ship wakes. The new experiment will consist of a major effort to provide ground truth on the site as the Space Shuttle passes over with the SAR. This experiment will include wave buoys, current meters, atmospheric measurements, and a ship making side-scan sonar runs to provide detailed calibration of the bathymetry. These field measurements will be made during several Shuttle passes, through different tidal states.

#### Summary of Marine and Coastal Geology in the UK

In summary, there are 75 or more institutions in the UK with some kind of program of instruction or research in marine science. However, the IOS and the Bullard Lab at Cambridge dominate the scene in basic research. IOS is funded (\$15 million annually) and to a degree managed by the NERC; it has over 350 employees in three locations. The program at the main laboratory in Wormley, south of London, concentrates on the deep oceans and has programs in physical, chemical, biological, geological, and geophysical oceanography. Geology and geophysics has a staff of about 30 professionals. They emphasize three areas of research: continental margins, mid-ocean ridges, and ocean-basin sedimentation. The branch at Bidston concentrates on waves, tides, and storm surges, with highly competitive work on modeling the dynamics of shallow seas. The branch at Taunton, which is being closed within 1 year, inventories and analyzes statistical data on ocean waves around the UK for coastal engineering and for planning purposes. The Taunton research staff also has had a long history of studies of the dynamics of sediment movement along the coast and in shallow shelf seas.

The universities at Liverpool, Southampton, Bangor, and Swansea have departments of oceanography with research and teaching. Probably the best known of these over the years has been Liverpool, which concentrates on physical and chemical oceanography. However, reductions, retirements, and changes in staff have weakened the department in recent years. The department at Southampton has programs in physical, chemical, geological, and biological oceanography and marine geophysics. Bangor has a department of physical oceanography, with programs in physical and chemical oceanography and marine geotechnics, as well as a department of marine biology. The program at Swansea is largely devoted to marine geology, but recently has branched out into the physical, chemical, and biological oceanography. The other, smaller university programs in the UK are mostly based on one to four staff members, who usually specialize in one particular branch of oceanography.

Government support from NERC will concentrate on two academic programs in oceanography rather than four. Support for the programs at the University of Liverpool and at the University College of Swansea will be discontinued, and all new oceanographic resources—including new faculty, staff, and facilities—will be concentrated at the University of Southampton and the University College of North Wales at Bangor. The goal is to bring Southampton and Bangor

up to faculties of 16 each. Additional resources will be made available so that the programs at these two institutions can achieve an international level of recognition and competition.

### Marine Geology in Israel

Three institutions are responsible for most of Israel's very modest research program in marine geology and geophysics: the Israel National Oceanographic Institute (INOI) in Haifa, the University of Tel Aviv, and the Department of Marine Geology and Geomathematics of the Geological Survey of Israel in Jerusalem. The program overall is modest and, at this time, greatly under-supported.

The INOI in Haifa is the largest and most comprehensive marine science program in Israel. Among their investigators are Dr. Zen Ben-Avraham, a geophysicist well known in North America, and Prof. Victor Goldsmith, a coastal geologist who for several years carried out research along the Atlantic coast of the US from a base at the Virginia Institute of Marine Sciences.

Ben-Avraham, who holds a joint appointment with INOI and the University of Tel Aviv, is well known in the US for his research on plate tectonics. He has published several review papers in recent years in journals such as *Science* and *Scientific American*. The region of the eastern Mediterranean and the Middle East is an area of rifting and continental collisions, so it has served as a base for his studies.

Ben-Avraham's current research has moved onto the continental shelf off the coast of Israel. Using side-scan sonar, he and his associates are mapping structural trends in considerable detail. Although this new project was started only recently, preliminary results show that the patterns of sedimentary deposits (packages) across and along the shelf are fault-controlled.

The main thrust of Victor Goldsmith's studies is to establish a sand budget for the Israeli coast. This called for a wave climatology of the relationship between wave actions, currents, and Mediterranean storms, which he and his colleagues have completed.

The Israeli Geological Survey marine geology research team is headed by John Hall. Hall's team consists of five or six professionals doing work ranging from coastal geology to global plate tectonics. These people are dedicated and enthusiastic about their work, but the political and economic situation in Israel is so unstable that it's a wonder that anything significant is done. Without US connections and assistance (although modest), my guess is that their contributions would be significantly reduced. Hall's group is doing hydrographic and geophysical mapping in the Red Sea, but I don't think it's earthshaking. Good solid research, nothing more.

In summary, for Israel it's my opinion that there are one or two outstanding marine geologists working there, and perhaps five or six good ones; but other than providing information of local importance, we shouldn't look toward their basic research programs for a significant breakthrough in either coastal or marine geology. They're below the critical mass in members and vastly underfunded. And the political and economic situation in Israel is so unstable that it's very difficult to concentrate on anything other than day-to-day functioning. Many Israeli scientists actually hold two positions in order to maintain a minimum standard of living.



### Summary

The rather bleak picture I've painted of marine research is not limited to the UK and Israel. With the exception of Norway and France, in every country I visited one of the first things the scientists wanted to know (usually within minutes after meeting) was, "what's the possibility of ONR funding for research in a foreign country." I even had inquiries from German scientists! I must stress, however, that I focused on basic research. It's my impression that support for applied research is somewhat better. For example, the MIZEX project was well supported by most nations involved. But obviously the justification wasn't "to better understand ice physics or marginal ice zone oceanography." The motivation was directly related to the Russian submarine threat associated with operations under the MIZ. Still, good fundamental research will be a product of the MIZEX project.

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